

1E03/49



P 03 / 00049

REC'D 30 SEP 2004

WIPO

PCT

Patents Office  
Government Buildings  
Hebron Road  
Kilkenny

I HEREBY CERTIFY that annexed hereto is a true copy of documents filed in connection with the following patent application:

Application No. S2002/0224

Date of Filing 27 March 2002

Applicant COMMERGY TECHNOLOGIES LIMITED, an Irish company of 133 Landsdowne Park, Ballsbridge, Dublin 4, Ireland.

Dated this 23 day of September 2004.

**PRIORITY  
DOCUMENT**

SUBMITTED OR TRANSMITTED IN  
COMPLIANCE WITH RULE 17.1(a) OR (b)



*Colerick*

An officer authorised by the  
Controller of Patents, Designs and Trademarks.

BEST AVAILABLE COPY

## REQUEST FOR THE GRANT OF A PATENT

PATENTS ACT 1992

The Applicant(s) named herein hereby request(s)  
[ ] the grant of a patent under Part II of the Act  
[ X ] the grant of a short-term patent under Part III of the Act  
on the basis of the information furnished hereunder.

1. Applicant(s)

COMMERGY TECHNOLOGIES LIMITED  
133 Lansdowne Park  
Ballsbridge  
Dublin 4  
Ireland.  
an Irish company

2. Title of Invention

A power converter

3. Declaration of Priority on basis of previously filed application(s) for same invention (Sections 25 & 26)

<u>Previous Filing</u> <u>Date</u>	<u>Country in or for</u> <u>which filed</u>	<u>Filing No.</u>
---------------------------------------	--	-------------------

4. Identification of Inventor(s)

Name(s) and adresse(s) of person(s) believed  
by the Applicant(s) to be the inventor(s)

George Young,  
an Irish Citizen of 11 Woodlands Park, Blackrock, County Dublin,  
Ireland.

5. Statement of right to be granted a patent (Section 17(2) (b))

The Applicant derives the right to apply by virtue of a Deed of Assignment dated March 26, 2002

6. Items accompanying this Request

- (i) [ X ] prescribed filing fee (Euro 60.00)
- (ii) [ ] specification containing a description and claims
- [ X ] specification containing a description only
- [ X ] Drawings referred to in description or claims
- (iii) [ ] An abstract
- (iv) [ ] Copy of previous application(s) whose priority is claimed
- (v) [ ] Translation of previous application whose priority is claimed
- (vi) [ X ] Authorisation of Agent (this may be given at 8 below if this Request is signed by the Applicant(s))

7. Divisional Application(s)

The following information is applicable to the present application which is made under Section 24 -

Earlier Application No.  
Filing Date:

8. Agent

The following is authorised to act as agent in all proceedings connected with the obtaining of a patent to which this request relates and in relation to any patent granted -

Name & Address

Cruickshank & Co. at their address recorded for the time being in the Register of Patent Agents is hereby appointed Agents and address for service, presently 1 Holles Street, Dublin 2.

9. Address for service (if different from that at 8)

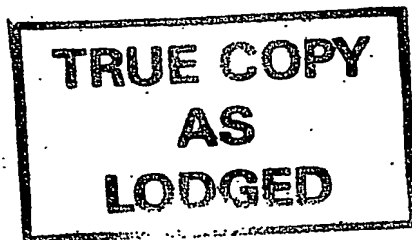
Signed Cruickshank & Co.

By: - *Michael Luce*

Executive.

Agents for the Applicant

Date March 27, 2002.

**"A Power Converter"****Introduction.**

5 The present invention relates to a controller for a power converter and in particular to a power converter of the DC-DC transformer type having a fixed duty cycle. The invention is further directed towards providing current mode control and clamping the voltage of a power converter.

10 It is desirable to operate a power converter under maximum duty cycle. The stress on components is minimised as current flows for almost all of the operating cycle. The transitions occur at fixed times, and thus it is relatively easy to provide for the switch-off of one device to generate a condition where a complimentary switch can be turned on in a lossless fashion. The need to store energy in input and output filter elements is limited due to the virtually continuous nature of power being drawn from the source and transferred to the load. Such filtering elements can thus be of modest size.

15 Examples of such converters discloses an isolated converter which is current fed. A further example is disclosed by Texas Instruments / Unitrode Seminar Series 1999 / 2000, which discloses an isolated converter section, which is closely coupled with one or more downstream buck converters.

20 In operating power converters it is necessary to provide a balanced drive for the devices of the converter. This is achieved normally by using current mode control. However, operating full duty cycle converters with current mode control is difficult in that one does not have an error signal to control the maximum current.

25 A further problem with high duty cycle power converters lies in relation to the output switching devices. It is often possible to use devices with lower voltage rating and thus lower on resistance and lower losses in a high duty cycle implementation. A problem with this is voltage spiking on the output switch devices in such converters, which are caused by resonance between the capacitance of these switches and leakage inductances lead to losses.

30 The present invention is directed toward providing a power converter with a controller to overcome the above-mentioned problems.

**Statements of Invention.**

According to the present invention there is provided a controller for use in a power converter comprising a current mode control and operating at a fixed duty cycle characterised in that the controller comprises means for controlling the duty cycle to provide current mode control in the power converter.

The advantage of controlling the duty cycle is that it is now much easier to implement current mode control in a power converter.

In one embodiment the power converter is a DC-DC transformer having a fixed duty cycle.

Preferably, the control means comprises an error amplifier for comparing the desired duty cycle and measured duty cycle of the power converter to provide a signal which is referenced against a current sense signal to provide output drive signals to implement current mode control in the power converter.

In another embodiment the duty cycle is dependent on the load and/or input voltage of the power converter.

In a further embodiment of the present invention there is provided a controller for use in a power converter comprising a current mode control and operating at a fixed duty cycle characterised in that the controller comprises a diode and resistor in series connected in parallel with an output inductor of the power converter to clamp the voltage of the converter close to the output operating voltage.

**Detailed Description of the Invention.**

The invention will be more clearly understood from the following description of some embodiments thereof, given by way of example only, with reference to the accompanying drawings, in which:-

Fig.1 illustrates a controller for a power converter (not shown) for carrying out the present invention,

Fig. 2 illustrates an additional control embodiment of the present invention.

Referring now to Fig. 1 there is illustrated a controller generally indicated by the reference-1 for a power converter (not shown). A measured duty cycle 2 of the power converter and a desired duty cycle 3 is fed into an error amplifier 4 where a compared value is fed into a logic circuit 5, for example a flip-flop. A current sense signal 6 measured from the power converter is also fed into the logic circuit 5. In response to the compared value from the error amplifier 4 and the current sense signal 6, a logic signal is generated to an output driver 7, which generates drive signals 8 and 9 to control the duty cycle of the power converter. An oscillator 10 controls the frequency at which the controller 1 generates the drive signals 8 and 9.

It will be appreciated that the controller 1 controls the duty cycle of the power converter as opposed to the output voltage of the converter as normally is the case. Some variants are possible allowing the desired setting for the duty cycle to be dependent on, for example load current and/or input voltage.

It will also be appreciated, to operate the power converter at near full duty cycle it is usually only relevant to consider "double-ended" topologies where the core reset is provided inherently. Topologies such as the half bridge, full bridge and push-pull converter type are thus controlled by the present invention.

Referring now to Fig. 2 there is illustrated an additional embodiment of the controller on the present invention illustrated by the reference numeral 20. A standard LC filter indicated by the inductor 21 and the capacitor 22 is connected between the rectifier switches of the power converter (not shown) to the output voltage. A diode 23 and resistor 24 connected in series and in parallel with the inductor 21 clamps any deviating voltage to a level very close to the output voltage of the power converter.

Operating at high duty cycle typically means that the driving voltage is within 1v, for example, of the output and the diode 23 used in parallel with the output inductor 21 is a very effective and simple clamp.

However, in operation the stresses on the diode 23 during turn on can be very severe as effectively a voltage source at the input is being fed into the uncharged capacitor 22. Depending on factors such as a soft-start approach, which can be adopted, the current limiting behaviour and leakage inductance's, it may be necessary to place the resistance 24 in series with the diode 23. This involves a certain trade off in the clamping effectiveness.

It will be appreciated in this specification that the invention is particularly effective for power converters having a high duty cycle. In many cases it may be commercially advantageous to use such a converter in cascade with a non-isolated converter to realise the overall power conversion function. The non-isolated converter is usually a simple buck converter with variable duty cycle and its combination with an isolated converter operating with near full duty cycle offer performance and cost advantages when compared with conventional approaches of using a variable duty cycle isolated converter.

In the specification the terms "comprise, comprises, comprised and comprising" or any variation thereof and the terms "includes, included and including" or any variation thereof are considered to be totally interchangeable and they should all be afforded the widest possible interpretation. The term theoretical refers to the scientific community and not the inventor.

The invention is not limited to the embodiments hereinbefore described but may be varied in both construction and detail.

5 PSQ204.Mar.14

10

15

20

25

30

BEST AVAILABLE COPY



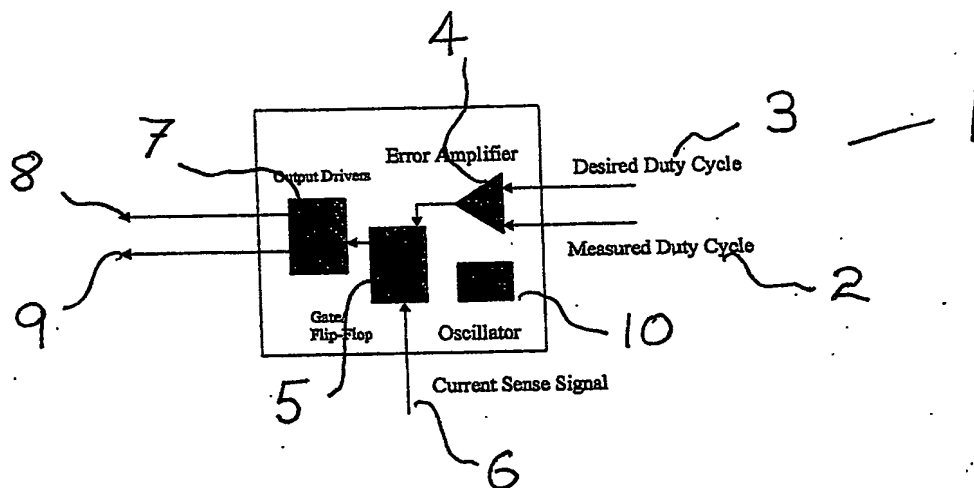


Fig 1

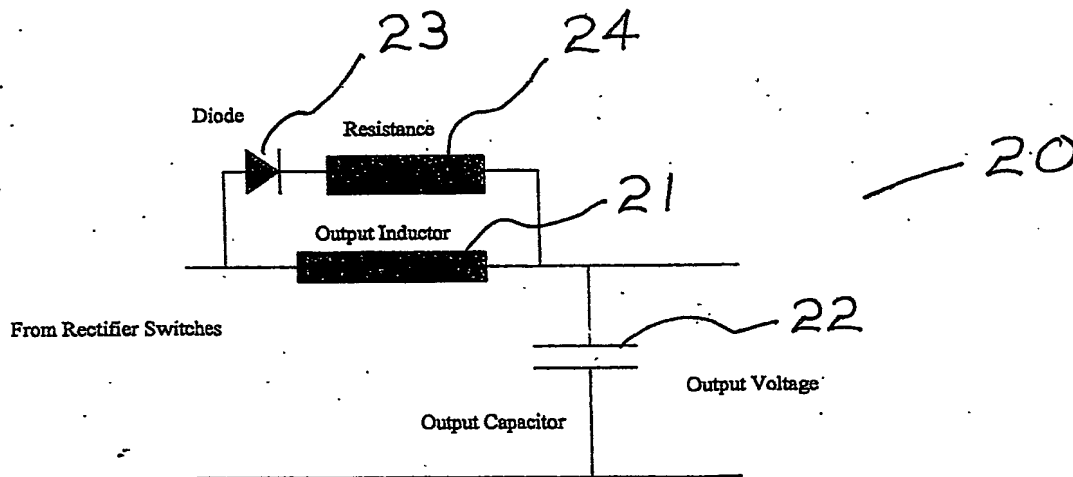


Fig 2.